Aircraft-Launched High-Resolution Pressure Pod

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LONG-TERM GOALS

The long-term goal of this program is to understand the physics of small-scale oceanic processes including internal waves, hydraulics, turbulence and microstructure that act to perturb and control the circulation in coastal oceans and, in doing so, affect the propagation of sound and light. Ongoing studies within the **Ocean Mixing Group** at OSU emphasize observations, interaction with turbulence modelers and an aggressive program of sensor / instrumentation development and integration.

OBJECTIVES

The objectives of this proposal are to:

1. construct a rugged, high-resolution pressure pod that can be launched from an aircraft. This will sink to the seafloor for periods up to 3 months. A timed release will permit recovery and surface reporting of all data; and
2. test algorithms to objectively detect nonlinear internal waves from seafloor pressure signals.

APPROACH

We are in the process of modifying existing electronics hardware to count Paroscientific pressure and temperature frequencies and to integrate GPS receiver and Iridium and wireless transceivers.

Existing high-resolution seafloor pressure data are being assessed using detection algorithms and new data sets are being obtained by piggy-backing on other projects.

WORK COMPLETED

An inertial motion package has been installed in a full-scale mockup. The purpose is to measure directly the impacts on the body when the parachute opens and when the body hits the water. Preliminary tests were conducted by dropping the mockup off the Yaquina Bay bridge (46 m bridge height). Photographs of the operation are shown in Figure 1. Further tests from aircraft are planned for later in 2008. Seafloor deployment tests in Puget Sound are planned for March 2009.

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14. ABSTRACT
The long-term goal of this program is to understand the physics of small-scale oceanic processes including internal waves, hydraulics, turbulence and microstructure that act to perturb and control the circulation in coastal oceans and, in doing so, affect the propagation of sound and light. Ongoing studies within the Ocean Mixing Group at OSU emphasize observations, interaction with turbulence modelers and an aggressive program of sensor / instrumentation development and integration.

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Figure 1 – Impact tests. Inertial motion package dropped from Yaquina Bay bridge. This was repeated many times with different parachutes and internal sensor configurations.

A nonlinear wave detection algorithm using wavelets has been developed and tested on seafloor pressure data obtained on the continental shelf of NJ during the SW06 experiment (August 2006).

Three existing Ppods were lent to Jim Lerczak (OSU) and Kipp Shearman (OSU) for deployment in Massachusetts Bay as part of a separate project. These will be recovered in late September 2008. Data will be shared with Lerczak and Shearman and used by us to test nonlinear internal wave detection algorithms.

RESULTS

The goal of the bridge drop measurements is to aid in parachute design and determine the forces on our pressure sensor upon impact. Results will aid in package design. An example that shows how this is being quantified using inertial motion measurements is shown in Figure 2.

Both continuous (CWT) and discrete wavelet transform (DWT) techniques have been applied to the pressure signals measured over the NJ shelf (Moum and Nash, 2008). An example using a triple-sech^2 CWT are shown in Figure 3. While this shows promise in detection across multiple scales, we have found that DWTs are more practical.

The effectiveness of a sample detection scheme is shown in Figure 4. Here, the blue bars represent waves detected from the pressure signal. The red bars confirm waves through velocity measurements on co-located ADCPs. Below wave pressure amplitudes of 250 Pa, our wavelet scheme now detects 45% false positives. Above 250 Pa, detection is perfect, albeit with a limited number of samples. Further tests will be conducted on data obtained from Massachusetts Bay.

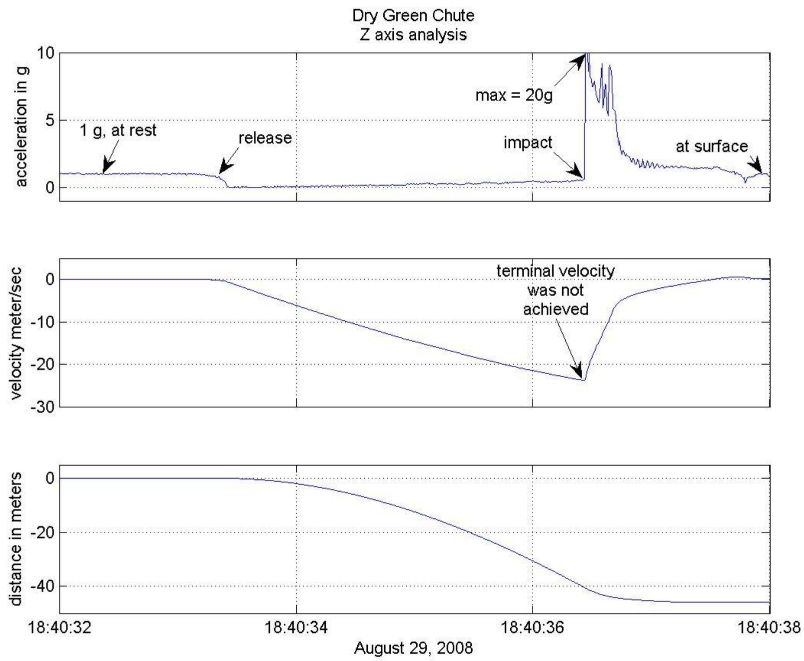

Figure 2 – Example bridge drop. The package senses 1 g at rest. As it is released, it initially senses 0 g. It does not reach terminal velocity with this particular parachute. It continues to accelerate to about 22 m/s until impact of 20 g with the water surface.

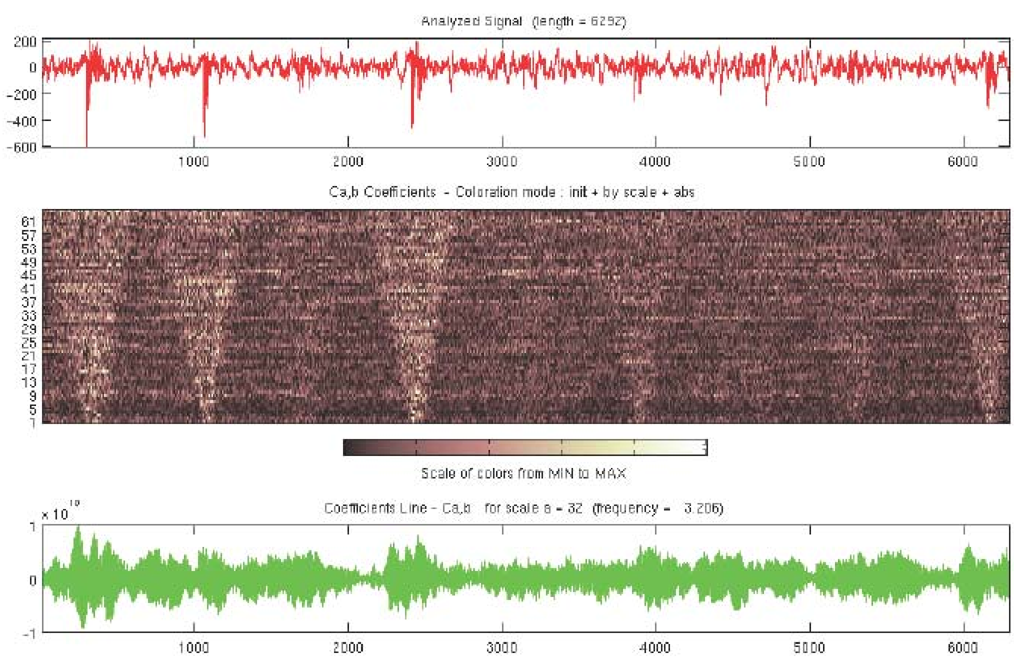

Figure 3 –Continuous wavelet transform (CWT) using a specially-defined KdV wavelet. Shown are the original signal (top), the CWT in time-scale space (middle), and the coefficients at scale 32 (bottom).

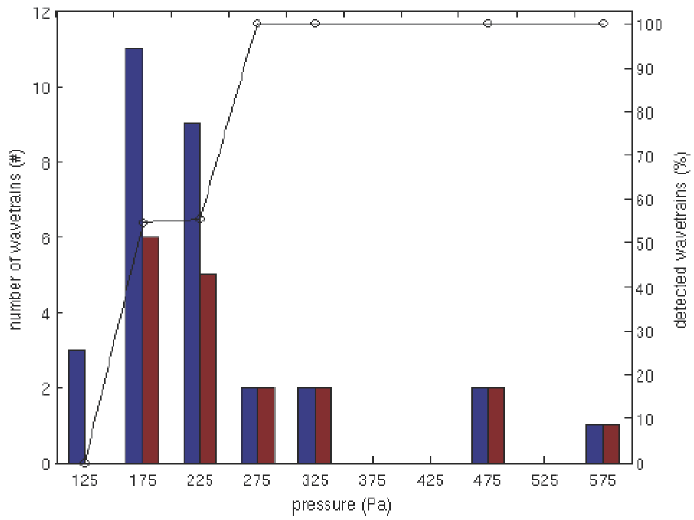

Figure 4 -Number of nonlinear internal wave trains detected in the pressure signal recorded at SW37 during SW06 (blue) and that have a counterpart in the vertical velocity signal (red), i.e. that are successfully identified. The black line shows the number of successfully detected wave trains in percent.

IMPACT/APPLICATION

The objective of this project is to develop an easy-to-deploy and inexpensive means to outfit continental shelves with seafloor-based nonlinear internal wave antennae. If successful, this will help in defining internal wave climates on continental shelves.

RELATED PROJECTS

Ppods have and are being used in related projects to help us gain experience with interpreting the measurement over a broad range of conditions. These have included measurements over Stonewall Bank (June 2008; Moum / Nash / MacCready / Skyllingstad) and in Massachusetts Bay (July – October 2008; Lerczak / Shearman).

REFERENCES

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